TECHNISCHE UNIVERSITÄT
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Exercise 4

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July 1, 2017

SVMs

Problem 1. *Lecture 9 - Slide 16 [...]*

Problem 2. *Due to linear classifiers being restricted to only two classes at a time, it would be necessary to consecutively apply one class versus the otheres combined. Therefore in case of multiple classes, nearest neighbor (NN) classifier is a better choice. Another advantage of NN classifiers is its ability to be used in learning methods. On the other hand, for small amount of classes, e.g. at most two or three, it is better to use linear classifier since it is faster. To overcome one disadvantage of linear classifiers, it is possible to map data using PCA into a different space where the data is linearly separable. Summing up, there is no better method for general problems, since both have their advantages and disadvantages.*

Problem 3. *A linear program is a linear optimization problem with linear constraints. Its dual program is again a linear optimization program. In case of strong duality of both problems, the duality gap, i.e. the difference of the optimal values of primal and dual problem, equals zero. Since this is not neccessarily the case for any linear program, there is a weaker statement that guarantees a bound on the optimal value of the primal program. In a lot of cases, the primal problem is rather difficult to solve, so solving a possibly easiser dual problem is a good alternative way, even if there is no strong duality.*

Problem 4. *Lecture 9 - Slides 63-66 [...]*

Problem 5. *The validation set serves as a test to find the best possible model which has been trainded beforehands. [...]*

Problem 6. *Support vector machines have a similar limitation as linear classifiers. Only two classes at a time can be handled, so there is an iterative scheme neccessary in order to deal with an arbitrary amount of classes. Also, there is a limitation given by memory consiumption and computation time. [...]*

Boosting, face detection and recognition

Problem 7. *Of course, we can use integral images for non-rectangular features since all features are discreticed with respect to pixel grid. So with rather much effort, it is possible to use integral images with e.g. ellipsiodal features. Another disadvantage, besides much effort, it is harder to adapt to different feature sizes since more pixels are involved.*

Problem 8. *Lecture 10 - Slide 17 [...]*

Problem 9 (...)**.** *If the $(Z_t)_t$ which serve as normalization factors are applied before multiplying by $\exp(\pm\alpha_t)$, then there is no upper bound on the weights. On the other hand if normalization is applied afterwards, then the weights are bounded by one from above.*

Problem 10. *Lecture 10 - Slide 33 [...]*

Problem 11 (...)**.**

Problem 12. *Lecture 10 - Slide 56 [...]*